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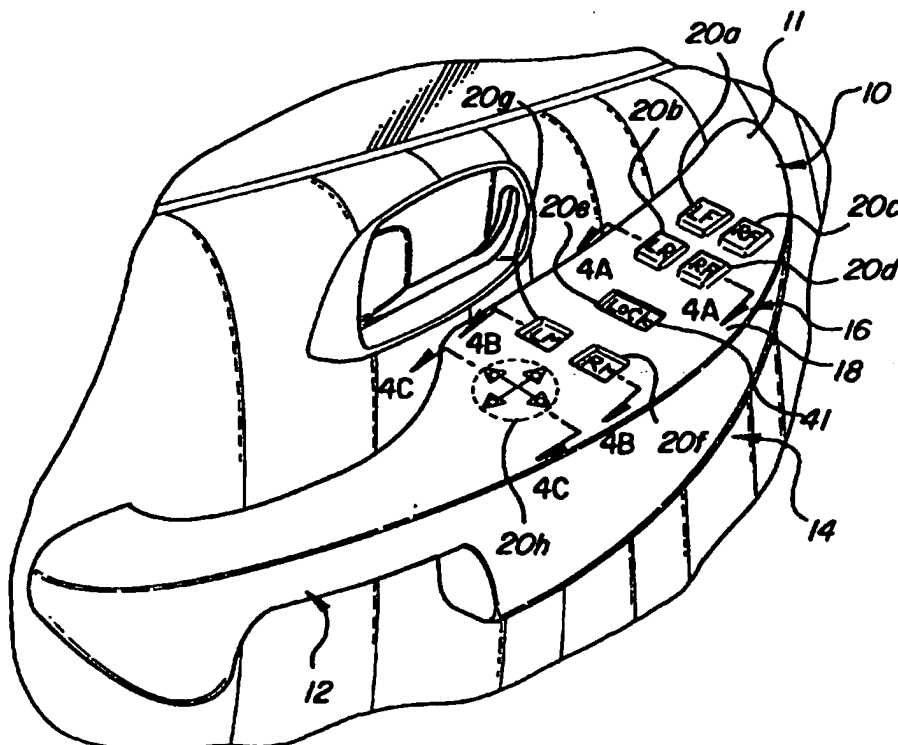
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(21) International Application Number: PCT/US96/14560 (22) International Filing Date: 11 September 1996 (11.09.96) (30) Priority Data: 60/003,614 12 September 1995 (12.09.95) US (71) Applicant (for all designated States except US): TEXTRON AUTOMOTIVE COMPANY INC. [US/US]; 750 Stephen- son Highway, Troy, MI 48083 (US). (72) Inventors; and (75) Inventors/Applicants (for US only): FILION, Scott [US/US]; 17 Hamel Farm Drive, Newmarket, NH 03857 (US). BATCHELDER, Bruce, A. [US/US]; 45 Wadleigh Falls Road, Lee, NH 03824 (US). (74) Agent: EVANS, John, C.; Reising, Ethington, Barnard & Perry, P.O. Box 4390, Troy, MI 48099-4390 (US).	(81) Designated States: CA, JP, KR, MX, US, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published <i>With international search report.</i> <i>Before the expiration of the time limit for amending the</i> <i>claims and to be republished in the event of the receipt of</i> <i>amendments.</i>	

(54) Title: ARMREST ELECTRICAL SWITCH ARRAY**(57) Abstract**

A vehicle interior trim panel electrical switch assembly (10) includes a switch panel portion (16) with a continuous outer surface (18). Force sensitive resistor switches (20a-20g) are supported on the switch panel portion (16) and are secured to the inner surface of a skin cover having a continuous outer surface (18) and forming the outer layer of a soft feel composite. The force sensitive resistor switches are embedded in the soft feel composite either as being cast in a layer of flexible foam or being applied within preformed openings in a layer of flexible foam in certain embodiments in which case they are associated with a circuit module (34) that negates preloading effects due to thermal expansion caused by changes in ambient conditions. In a preferred embodiment the

correction occurs due to a circuit configuration that corrects for such preloading effects on a deflection rate basis. The circuit module (34) for each switch (20a-20g) may also include a relay in high power applications.



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ARMREST ELECTRICAL SWITCH ARRAY**TECHNICAL FIELD**

5 This invention relates generally to electrical switches incorporated into continuous trim panel surfaces and more particularly to such trim panels having a flexible outer skin; an intermediate layer of flexible foam and a relatively rigid substrate.

10

BACKGROUND OF THE INVENTION

 Soft interior trim panels are currently used for vehicle interiors. These panels generally have an
15 outer cover of leather, a plastic material that is similar to leather or a fabric material. A foam material on the back side of the outer cover provides the cover with a softer feel. A substrate is employed on the back side of the foam to support the foam and the
20 outer cover and for mounting the soft interior trim panel in a vehicle. The outer cover or skin, foam backing and substrate in combination define a composite that is known as a soft feel composite.

25 Electrical switches are currently used in applications such as arm rests, console controls and the other interior trim components that are made of a soft feel composite. In some cases such electrical switches extend through an aperture in a bezel that passes
30 through an aperture in a trim panel. Such electrical switches may either be secured to the bezel or attached to the same structure that the trim panel is attached

to. These electrical switches and bezels are hard and rigid. The gaps and cracks formed between the bezels, switches, and a trim panel may catch on clothing and cleaning materials. The switches have crevices that are
5 difficult or impossible to clean out, allow the passage of air and moisture and may transfer heat into or out of a vehicle passenger compartment. Furthermore, noticeable fit and finish problems can arise in such arrangement since it is difficult to always accurately
10 fit a bezel around a switch component or switch array. An example of such arrangements such as shown in United States Patent No. 4,975,547.

Membrane switches may also be used in this type of application as is described in U.S. Pat. No.
15 5,448,028 issued Sep. 5, 1995 to Fillion et al. Fillion discloses a membrane switch supported by a trim panel beneath a layer of flexible skin. Other examples of multiple sheet membrane switches for interior applications are shown in United States Patent Nos.
20 4,612,425 and 4,742,192. Such membrane switches are difficult to mold in place without introducing preload effects that can cause inadvertent accessory actuations. Moreover, membrane switches are "on-off" type switches that do not allow an occupant to vary the amount of
25 electrical power flowing to the device that the switch controls.

United States Patent No. 5,398,962 has a force resistance sensor 30 having a low profile that is connected to the underside of a flexible outer cover and
30 supported against a relatively rigid inner cover that overlies an air bag assembly. The sensor 30 is associated with a circuit that will compensate for

thermal differences and includes a circuit that will provide a time delay before a given change in resistance will sound the horn. However, such an arrangement does not define a soft feel composite that is suitable for
5 arm rest configurations or for protection against side impacts.

What is needed is an automotive interior door electrical switch array that is protected against fluid and dust contamination and is less disruptive of
10 interior design contours such as smooth continuous trim panel surfaces and that will have a soft touch feel and also be able to compensate for changes in ambient conditions that might otherwise operate the switches. To accomplish this objective a conventional force resistor
15 of the type shown in United States Patent Nos. 5,222,399 and 5,086,652 is embedded in a soft feel substrate located in a side impact region of a vehicle wherein the soft feel substrate protects the switch mechanism. Furthermore, the switch mechanism is associated with a
20 circuit that will prevent thermal expansion from adversely affecting the function of the array.

SUMMARY OF THE INVENTION

25 A vehicle interior trim panel electrical switch assembly (10) of the type for actuating various vehicle electrical components comprises an interior trim panel (12) including a switch panel portion (16) having a continuous outer surface (18) and an electrical switch
30 array (20) that is supported on the switch panel portion (16) of the interior trim panel (12). Characterizing the invention, the electrical switch array (20) is

embedded in a soft feel substrate and the switch array (20) includes low profile force sensitive resistor switches (20a-20g) that are protected by the soft feel substrate against side impact loading while operating electrical components such as power locks, power window lifts, power seat adjusters and power rear view mirror actuators through a wide range of ambient temperature conditions.

Unlike prior art door or console switch panels with mechanical switches or membrane switches the force sensitive resistor switch (20a-20g) of the present invention is protected against fluid and dust contamination and can be molded in place without being disruptive of interior design contours such as smooth continuous trim panel surfaces while maintaining the operative characteristics of the switch. Furthermore, force sensitive resistor switches have lower profiles than membrane switches and conventional mechanical switches and therefore take up less space in the trim panel (12) and can easily be incorporated into or under the continuous outer surface (18) of the switch panel portion (16). Furthermore, the embedding thereof in a protective soft feel substrate will protect them against side impact forces.

Incorporating the switch array (20) into a soft feel composite or under the continuous outer surface (18) enables the switching surface on an arm rest to be substantially flat to define a side arm rest surface adjacent vehicle passengers and wherein the side arm rest surface will provide a comfortable plush feel arm resting surface without impairing the operation of the switch array. More particularly, the use of force

sensitive resistor switches (20a-20g) provides a surface with continuous soft touch switching features and eliminates the need for a separate add-on bezel in mounting the switches 16-22. Force sensitive resistor switches, or "touch" switches as they are commonly called, are also very light in weight compared to conventional mechanical switches. Therefore, they not only require less space in a trim panel (12), but are also less massive and are less of a factor in vehicle side impact collisions. Accordingly, they are less susceptible to damage in areas such as side door arm rest applications and thus can be operated following such impacts to open windows, adjusts seats or the like in order to assure easier egress from the vehicle following an accident.

BRIEF DESCRIPTION OF THE DRAWINGS

To better understand and appreciate the invention, refer to the following detailed description in connection with the accompanying drawings:

Figure 1 is a perspective view of a vehicle armrest switch panel constructed according to the present invention;

Figure 2 is a cross sectional side view of a portion of the switch panel of Figure 1 showing one alternative switch sensor installation according to the present invention;

Figure 3 is a cross sectional side view of a switch panel constructed according to a second alternative switch sensor installation according to the present invention;

Figure 4A is an enlarged cross sectional view of taken along the line 4A-4A in Figure 1 looking in the direction of the arrows showing raised areas formed over switch sensors in the continuous outer surface of a switch panel constructed according to the invention;

Figure 4B is an enlarged cross sectional view taken along the line 4B-4B in Figure 1 looking in the direction of the arrows showing depressed areas formed over switch sensors in the continuous outer surface of

a switch panel constructed according to the present invention;

5 Figure 4C is an enlarged cross sectional view taken along the line 4C-4C in Figure 1 looking in the direction of the arrows showing raised areas formed around switch sensors in the continuous outer surface of a switch panel constructed according to the invention; and

10 Figure 5 is a cross-sectional side view of a switch panel showing a third alternative switch sensor installation according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

15 A vehicle interior trim panel electrical switch assembly of the type for actuating various vehicle electrical components is shown at 10 in Fig. 1 as an arm rest 12 for a vehicle door 14. The arm rest 12 is formed as a soft feel composite 15, shown in section in Figure 2, that includes a switch panel portion 16 that has a continuous outer surface 18 covering a switch array 20 including eight electrical switches 20a-20h. Four of the eight electrical switches 25 are for opening and closing windows, one of the switches is for locking and unlocking doors, two are for selecting either the left or the right side view mirror for adjustment, and one multiposition switch is for adjusting the position of whichever side view mirror is selected by the two switches just described.

30

The arm rest 12 is shown as a separate member from the vertical door panel 14, but the arm rest and vertical door panel 14 could be formed as one integral interior panel. Furthermore, the vehicle interior trim panel electrical switch assembly 10 can be employed on any interior surface of a vehicle. It can be part of the dash and instrument panel, part of a headliner and overhead console between seats or any other part of a vehicle interior.

10

Additionally, the switch array 20 can vary in number and location. For example, in another application a single switch can be provided to operate an overhead light; a power operated sun roof or other electrically switched accessory on a motor vehicle. Other arrangements will depend upon the system being controlled by the switch array underlying a switch panel portion.

20

The soft feel composite 15 and switch panel portion 16 of the interior trim panel electrical switch assembly 10 comprises a substrate 22, a foam layer 24 bonded directly to the substrate and a flexible skin 26 with an underside surface 28 bonded directly to the foam layer. The switch panel portion 16 may be formed from any of a number of well known materials and by any one of a number of methods to include the methods and materials described in U.S. Pat. Nos. 5,448,028; 5,340,149 and 5,280,947, assigned to the assignee of the present invention, and incorporated herein by reference.

30

A variable resistance sensor 30 is supported on the switch panel portion of the interior trim panel. In accordance with the present invention, the sensor 30 is a force sensitive resistor having a low profile that
5 allows it to be easily incorporated into or under the continuous surface of the switch panel portion 16 which adds to the comfort and plush feel of the vehicle interior.

10 The use of a force sensitive resistor 30 in the embodiment shown in Figure 2 provides a smooth surface region 32 that has no bumps or ridges and thus provides a continuous soft touch switching capability. It eliminates need for a bezel in mounting the switch as
15 shown in prior art arrangements such as shown in United States Patent No. 4,975,547. Also, it eliminates raised surface features such as disclosed in the aforesaid '028 patent. Furthermore, it eliminates the need for multiple sheet membrane switches for interior
20 applications as shown in United States Patent Nos. 4,612,425 and 4,742,192 and can provide a switching function in association with an associated circuit or electronic control module 34 that can provide an on-off function that is not subject to thermal expansion
25 differences.

Force sensitive resistor sensors 30 and associated circuit or electronic control modules 34 are light in weight and thin in profile compared to
30 conventional mechanical switches. Therefore, they require less space in a trim panel and are less effected by side impacts when embedded in a soft feel composite.

The sensor 30, more particularly, is the type of thin profile unit that when flexed has a change of resistance ΔR that, when applied to an circuit or electronic controller module 34 during a time span ΔT will cause an electronic switch therein to open or close. A drift in resistance due to environment or manufacturing installation does not activate the circuit. The circuit effectively re-zeroes itself after a drift, since it operates only on ΔR over a time span ΔT as more specifically set forth in United States Patent No. 5,398,962 which is incorporated herein by reference.

As described above, the force sensitive resistor sensor 30 is disposed beneath the continuous outer surface of the switch panel portion and is embedded in the soft feel composite 15 where it is protected against side impacts and the like. While being protected such embedding subjects the sensor 30 to changes in loading due to thermal expansion differences that occur during swings in ambient temperature. To avoid the affect of such preloading effects, the force sensitive resistor sensor 30 is associated with a module 34 that defines a "zeroing" circuit that negates preloading effects on a deflection rate basis. Such preloading effects are common particularly when a switch is molded in place. Therefore, the zeroing circuit allows the force sensitive resistor switch to be molded in place, if desired, without adversely affecting control operation. The zeroing circuit also negates long term dimensional changes such as result from thermal expansion. An example of such a zeroing circuit

is set forth in the aforesaid United States Patent No. 5,398,962.

5 The module 34 if desired can be directly
coupled to a load such that the variable resistance can
increase upon increased finger loading so as to allow
occupants to vary the amount of electrical power flowing
to the accessory controlled by the switch by varying the
amount of finger pressure applied to the flexible skin
10 overlying the switch so as to provide a variable speed
window lift action since, if desired an associated
electronic control module can be programmed to produce
an output that will power an electric drive window lift
motor to vary in speed in accordance with the level of
15 resistance produced upon deflection of the sensor 30.
By controlling the amount of electrical power, occupants
can control, for example, the speed of power window
movement.

20 In high current applications, a relay 36 may
be employed to minimize the amount of current passing
through the variable resistor switch as shown in the
circuit diagram in FIGURE 2 wherein the module 34 is
connected through a relay 36 to a load.

25 The force sensitive resistor sensor 30 is
molded in-place between the substrate and the skin as
shown in Figure 2. In-place molding may be accomplished
by any one of a number of well-known methods including
30 the method described in U.S. Pat. No. 5,448,028 and
incorporated herein by reference.

The force sensitive sensor 30 may, alternatively, be embedded in the flexible skin. In other words, the switch is held in place as skin-casting material is cast around it as more particularly shown in
5 United States Patent No. 5,269,559 assigned to the assignee of the present invention and incorporated herein by reference.

The force sensitive resistor switch may also
10 be bonded, in a post-applied fashion, to the underside surface of the skin as shown in Figure 3 at 30a. The underside surface of a flexible skin 26a on a soft feel composite 15a is made accessible via depressions 38 formed through the substrate 22a and foam layer 28a. In
15 this embodiment a smooth surface region 32a can be provided.

In each embodiment shown in Figures 1, 2 and 3, many types of adhesives, including acrylics, urethanes, etc., may be used to bond the sensors to a
20 trim panel's outer skin. The adhesives may be applied in any one of a number of forms to include pressure-sensitive backings and sprayed-on hot melts.

As another alternative, the outer skin can be
25 vac-formed or cast and can be applied directly over the substrate by vacforming. In the embodiment in FIGURE 5, the skin 26b is shown as a PVC layer 26b' with a cast PVC foam layer 26b". It is directly formed over a force sensitive resistor sensor 30b on a substrate 22b. The
30 force sensitive resistor sensor 30b may be bonded to the retainer by being vac-formed in place as the skin is vac-formed over the substrate 22b. In the embodiment of

Figure 5, the control wires go through pre-existing holes 40 in the substrate 22b and the sensors 30b are loaded in place. Then the skin 38 is vacuum formed over the entire surface of substrate 22b and mounted sensors
5 30b. In this embodiment the wires are shown connected to a module 34b.

In the various embodiments, the foam material can be molded in place, pre-molded and can be any
10 suitable foam material that will provide a desired backing, either a soft feel or, if desired, an energy absorbing characteristic as provided by the RIM materials disclosed in United States Patent No. 5,232,957 also assigned to the assignee of the present
15 invention and incorporated herein by reference.

Indicia 41 can be printed on an outside face surface of the flexible skin to indicate to occupants the function of each force sensitive resistor switch as
20 shown in Figure 1.

A transparent protective coating 43 may then be applied to the outside surface of the flexible skin and to the indicia. The coating is applied as a liquid
25 and is then dried to form a thin durable protective film that keeps the indicia from rubbing off - as is described in greater detail in U.S. Pat. No. 5,448,028 and incorporated herein by reference.

30 If desired, as shown in Fig. 4A at 42, a raised area may be formed in the flexible skin adjacent the force sensitive resistor switch for guiding an

occupant's finger tip to a location where the occupant may apply force to actuate the force sensitive resistor switch. Alternatively, as shown in Fig. 4B at 44, a depressed area may be formed. Other types of surface discontinuities may be formed in the flexible skin as shown by raised nibs 46 in Fig. 4C for the same purpose and may be formed according to methods set forth in U.S. Pat. No. 5,448,028 and are incorporated herein by reference.

10

This is an illustrative description of the invention using words of description rather than of limitation.

15

Obviously, many modifications and variations of this invention are possible in light of the above teachings. Within the scope of the claims, where reference numerals are merely for convenience and are not limiting, one may practice the invention other than as described.

20

We claim:

1. A vehicle interior trim panel electrical switch assembly of the type for actuating various vehicle electrical components, said vehicle interior trim panel electrical switch assembly (10) comprising:
an interior trim panel (12) including a switch panel portion (16) having a continuous outer surface (18); said switch panel portion (16) of said interior trim panel (12) further comprising a substrate (22), a foam layer (24) bonded directly to said substrate (22) and a flexible skin (26) with an underside surface (28) bonded directly to said foam layer (24);
a low-profile force sensitive sensor (30) disposed beneath said continuous outer surface (18) of said switch panel portion (16).
2. A vehicle interior trim panel electrical switch assembly (10) as defined in claim 1 wherein said force sensitive sensor (30) is embedded in said flexible skin (26).
3. A vehicle interior trim panel electrical switch assembly (10) as defined in claim 1 wherein said force sensitive sensor (30) is molded in place between said substrate (22) and said flexible skin (26).
4. A vehicle interior trim panel electrical switch assembly (10) as defined in claim 1 wherein said force sensitive sensor (30) is attached to said underside surface (28) of said flexible skin (26).

5. A vehicle interior trim panel electrical switch assembly (10) as defined in claim 1 wherein said force sensitive sensor (30) is attached to said substrate (22).

5

6. A vehicle interior trim panel electrical switch assembly (10) as defined in claim 1 further including indicia (41) printed on said continuous outer surface (18).

10

7. A vehicle interior trim panel electrical switch assembly (10) as defined in claim 6 further including a transparent protective coating (43) applied to said continuous outer surface (18) and to said indicia (41).

15

8. A vehicle interior trim panel electrical switch assembly (10) as defined in claim 1 further including a depressed area (44) in said flexible skin (44) adjacent the force sensitive resistor sensor (30).

20

9. A vehicle interior trim panel electrical switch assembly (10) as defined in claim 1 further including a raised area (42) on said flexible skin (26) adjacent the force sensitive resistor switch (30).

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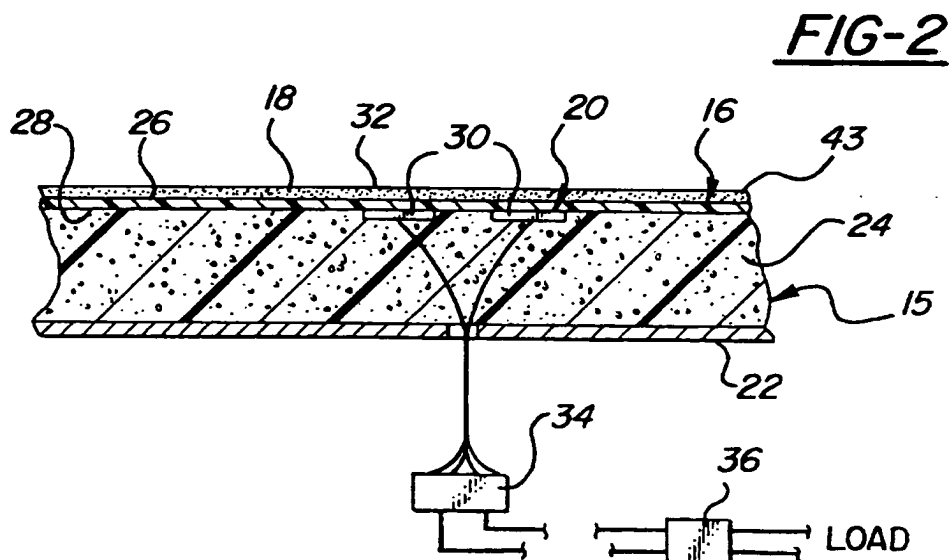
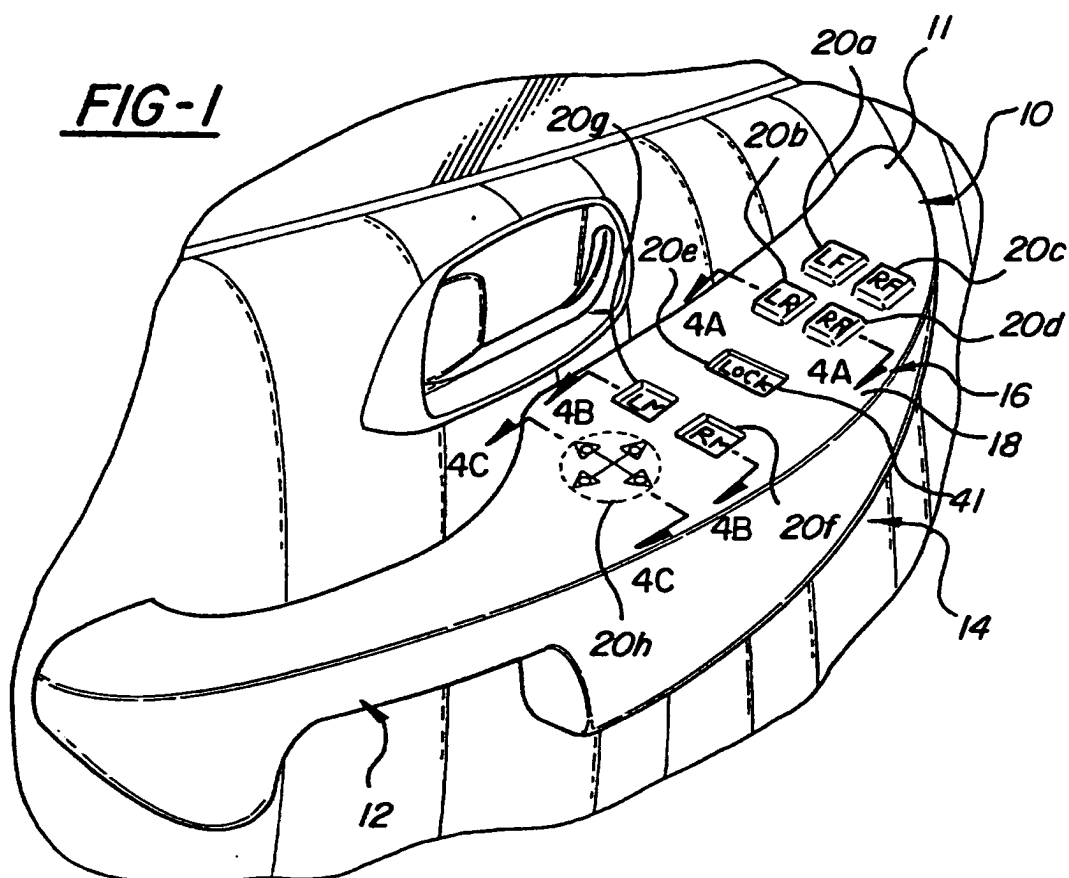
10. A vehicle interior trim panel electrical switch assembly (10) as defined in claim 1 wherein said low-profile force resistor sensor is a variable resistance sensor.

30

11. A vehicle interior trim panel electrical switch assembly (10) as defined in claim 1 including a control module (34) having a circuit that is connected to said variable resistance sensor and operative to
5 produce a control output signal in response to a predetermined difference in resistance following a predetermined time delay following actuation of the electrical switch assembly.

10 12. A vehicle interior trim panel electrical switch assembly (10) as defined in claim 3 further including a relay connected to said force sensitive resistor switch (16-22).

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2/2

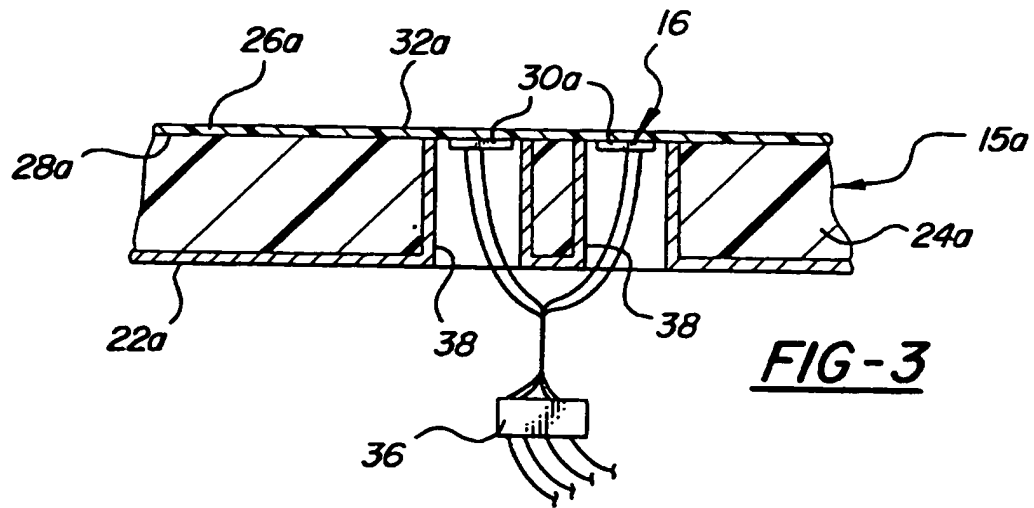


FIG-3

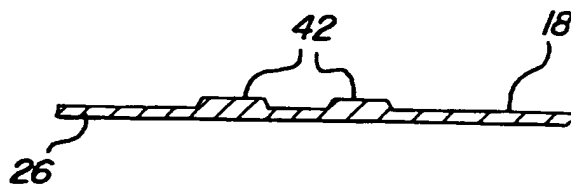


FIG-4A

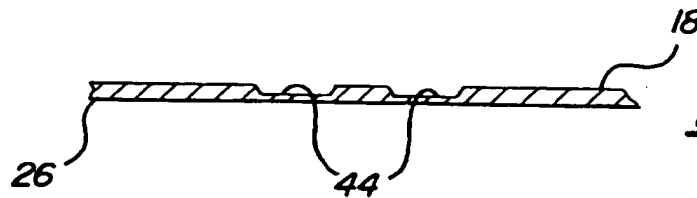


FIG-4B

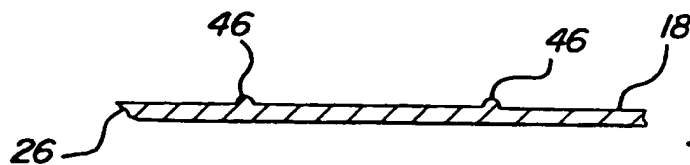


FIG-4C

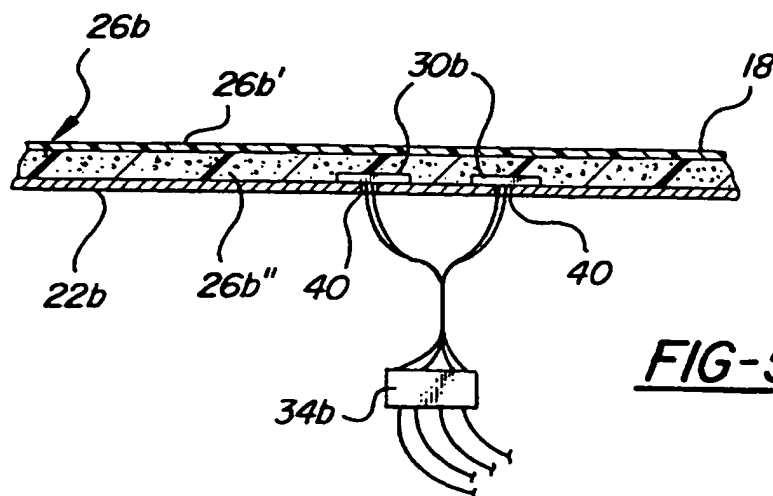
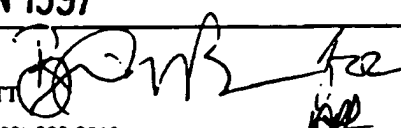


FIG-5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US96/14560

A. CLASSIFICATION OF SUBJECT MATTER IPC(6) : H01H 9/00; A47C 7/54 US CL : 200/52R, 5R, 302.1, 308; 296/153; 297/411.21 According to International Patent Classification (IPC) or to both national classification and IPC														
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) U.S. : Please See Extra Sheet.														
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched NONE														
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) APS														
C. DOCUMENTS CONSIDERED TO BE RELEVANT														
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.												
X ----- Y	US 5,448,028 A (FILION et al) 05 September 1995, figures 2-5 and col. 2, line 50 through col. 8, line 26	1-9 ----- 10-12												
Y	US 5,398,962 A (KROPP) 21 March 1995, Note columns 3 and 4 and also figure 5.	10-12												
Y	US 5,269,559 A (FILION et al) 14 December 1993 Note figure 3 and col. 2, line 60 to col. 3, line 18	8-11												
A	US 5,222,399 A (KROPP) 29 June 1993 Note cover page, figure and abstract	8-11												
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.														
<table border="0"> <tr> <td>* Special categories of cited documents:</td> <td>T later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</td> </tr> <tr> <td>"A" document defining the general state of the art which is not considered to be of particular relevance</td> <td>X document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</td> </tr> <tr> <td>"E" earlier document published on or after the international filing date</td> <td>Y document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</td> </tr> <tr> <td>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</td> <td>& document member of the same patent family</td> </tr> <tr> <td>"O" document referring to an oral disclosure, use, exhibition or other means</td> <td></td> </tr> <tr> <td>"P" document published prior to the international filing date but later than the priority date claimed</td> <td></td> </tr> </table>			* Special categories of cited documents:	T later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention	"A" document defining the general state of the art which is not considered to be of particular relevance	X document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone	"E" earlier document published on or after the international filing date	Y document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art	"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	& document member of the same patent family	"O" document referring to an oral disclosure, use, exhibition or other means		"P" document published prior to the international filing date but later than the priority date claimed	
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Date of the actual completion of the international search 05 DECEMBER 1996		Date of mailing of the international search report 30 JAN 1997												
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230		Authorized officer JAMES R. SCOTT  Telephone No. (703) 308-2013												

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US96/14560

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5,086,652 A (KROPP) 11 February 1992 Note figs. 7 and 8 and col. 3, lines 15-51	8-11
A	US 4,975,547 A (NAKAYAMA et al.) 04 December 1990 Note fig. 14	11,12
A	US 4,742,192 A (LEVINE et al) 03 May 1988 Note figs. 3-6 and switch 12 of general interest only	1-12
A	US 4,612,425 A (KANAI et al.) 16 September 1986 Note membrane switches 6 in figs. 1 and 2-of general interest only	1-12

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US96/14560

B. FIELDS SEARCHED

Minimum documentation searched

Classification System: U.S.

73/862.041-862.045, 862.625-862.627, 862.68; 200/52R, 5R, 5A, 86R, 302.1-302.3, 308-317, 512-517; 296/153;
297/411.2, 411.21; 338/2, 4, 5, 47, 99, 114